The Arctic Pilot Project

a submission to the

Environmental Assessment and Review Process

by the

Canadian Arctic Resources Committee

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1. INTRODUCTION

The Canadian Arctic Resources Committee (CARC) welcomed the Arctic Pilot Project (APP) when it was first announced because it seemed unique among northern energy projects: it was relatively small and flexible, and did not irrevocably commit Canada to one particular frontier basin. As a "pilot" project, it was thought to minimize the environmental, social and economic risks of industrial development in the Arctic. At the same time, the project seemed to offer exciting benefits: the pioneering of year-round navigation in the Arctic, the development of new technological capability, the assertion of Canadian sovereignty, and the acceleration of northern research.

A detailed examination of the documents filed by the APP's main sponsor, Petro-Canada, reveals however that the project does not live up to its promise. The APP cannot be justified on the grounds of domestic energy need - if it ever could. Cheaper and more reliable alternatives exist, alternatives that pose fewer economic, technical, environmental and socio-economic risks. And if it cannot be demonstrated that the APP meets Canadian energy priorities, then how can it be justified? If the project generated substantial industrial benefits, it would still have considerable merit. It now appears, however, that there is little likelihood that these potential industrial benefits will be achieved. Indeed, it is impossible at this time to estimate the project's contribution to technological excellence in Canada. No government or industry plan exists to maximize opportunities and Petro-Canada

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has not done any studies to support its claim of industrial spin-off benefits. Already we are advised that the key component of the "pilot" project - its ships - will be built abroad.

CARC therefore cannot endorse the APP. This does not mean that the committee does not support the goal of developing Canadian technological and year-round operational competence in arctic seas. As described in the committee's submission to the National Energy Board's 1978 hearings on natural gas supply and demand, we believe that the key to arctic development lies in marine systems that are both economically viable and environmentally acceptable.* We hold this belief with full knowledge that the environmental risk of transporting resources - particularly oil - from these areas by the marine mode is severe; and we hold this belief notwithstanding our firm conviction that the long-term national interest requires the settlement of aboriginal rights before any large-scale industrial development proceeds.

Canada is just beginning to develop a pragmatic policy framework to advance the national interest in the Arctic. Federal priorities for northern Canada give paramount importance to environmental protection and the fulfilment of the aspirations of native people. National objectives seek, among other things, to encourage the viable economic development of the North and to maintain Canadian sovereignty

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*See CARC, "A submission to the National Energy Board natural gas supply and demand hearings," Northern Perspectives, vol. 6, no. 5 (1978): 1-5.

and security. Specific federal policies have reinforced these priorities and objectives. The 1973 commitment to achieve world excellence in operating on and below ice-covered waters and the 1977 policy to develop a ship-building industry capable of responding to the demand for marine transportation in the Canadian Arctic are cases in point. And because of recent international developments, northern policies are being tied increasingly to the objective of achieving self-reliance or self-sufficiency in energy. Indeed it is this objective, more than any other, which is driving northern development today.

CARC supports this policy framework for decision-making and recognizes that it is basic to any assessment of northern projects such as the one being conducted by EARP.

EARP is the first agency to review the Pilot Project. As such, the Panel must establish for itself the full implications and nature of the project. Although not every aspect of the project is unique, several elements are and will require the testing of new knowledge. Also, whether intended or not, the first review sets the context for others. Hence EARP has an opportunity to influence the future evolution of the Arctic Pilot Project.

Fundamental to any environmental assessment is the question of need and hence of what risks are acceptable and what terms and conditions can be justified. The first consideration is therefore energy policy.

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2. ENERGY CONSIDERATIONS

The APP is first and foremost an energy project. Although its importance transcends its energy implications - a fact continually stressed by its sponsors - it can only proceed if a market can be found for the gas it plans to carry. In evaluating the merits of the APP, it is here therefore that one must begin. Does a domestic need exist for frontier gas? If so, is the APP the optimal solution to threatening shortages? The answer to both these questions is no.

At a time of national and international energy crisis, our national oil company has chosen as its first project to present to the regulatory and assessment agencies, a proposal that has virtually no role in solving our domestic energy problems. The project is an energy export scheme.

The APP would export by displacement twice as much gas as it would deliver to market. Its delivery pattern, as will be argued below, makes it poorly suited for meeting domestic requirements. Hence, the *raison d'être* behind the APP must be subjected to rigorous scrutiny. Such scrutiny, unfortunately, is difficult both because numerous gaps remain in the application filed in January 1979 and also because fundamental parts of the project continue to evolve. The recent proposal to blend APP exports with equivalent volumes of western gas is a case in point.

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Nevertheless, it is possible on the basis of what is now known about the APP to discuss in a preliminary way some of the project's more important implications for Canadian energy policy. This is done under two main headings: security of supply, and exports.

2.1 Security of Supply

Petro-Canada claims that the "project will add significantly to the security of Canada's energy supply through connection of reserves to markets, through reduction in embargo-related oil storage cost, through the Project's positive effect on exploration, and by improving knowledge of the productivity of Arctic Islands reservoirs." Each of these claims will be reviewed individually.

2.1.1 Connection of reserves to market

The Arctic Pilot Project would connect the Drake field on Melville Island (reserves of 5.5 Tcf) to the Canadian market by delivering 225 MMcf of gas a day by LNG carrier to a terminal in eastern Canada yet to be selected. These deliveries are now projected to start in 1986. Liquefied natural gas from Melville Island would "back out" (displace) equal volumes of western gas carried to eastern Canada (through the proposed Quebec and Maritimes (Q & M) pipeline) and would be sold at prevailing domestic prices. The displaced volumes of western gas would then be exported to the United States at LNG prices after having

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been blended with equivalent volumes of new gas exports at the regular border price. The APP would thus entail the export of up to 450 MMcfd from Alberta for perhaps as long as 20 years for an accumulated export of almost 4 Tcf.

Since Petro-Canada is now considering the export of twice as much Alberta gas as LNG delivered from Melville, the claim that the APP would increase Canadian security of supply by connecting new reserves to market is ambiguous at best. Indeed, over its 20-year life, the APP could export the equivalent of 80 per cent of the reserves it would be connecting to market.

In assessing the contribution the connection of the Melville Island (Drake) reserves could make towards Canadian security of supply, three factors in particular must be considered: (a) Does Canada need to develop a frontier gas supply at this time? (b) Are there alternative supplies or modes of transportation that might be more advantageous? (c) Would the Pilot Project be a reliable delivery system?

(a) Need

The APP sponsors recognize explicitly that no domestic market exists for APP gas now or in the immediate future. In their application to the NEB, they state:

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> The Applicants point out that Canadian market prices and the reserves in the conventional areas of gas supply in Canada are such that there is no present Canadian market for Melville Island gas...

Indeed, this is why Petro-Canada is seeking an export licence for 20.5 years. In addition, the fact that the APP exports would have to be blended with cheaper western gas suggests that no market for Melville gas exists in the United States either.

Petro-Canada's assessment of domestic need is confirmed by the National Energy Board's latest estimate of natural gas supply and demand which shows conventional reserves meeting demand until 1997. Assuming that this forecast is accurate, the APP could begin to meet domestic needs at that time. Since the export licence the APP is seeking would not expire until 2006, however, the APP would have to be "incremented" (by adding ships) to increase Canadian supply.

Even so,the APP's contribution would probably be modest. The NEB estimates total Canadian gas demand in 2000 at about 2.97 Tcf, of which the APP with two ships could supply less than 3 per cent. If only eastern Canadian markets are considered, it would still take 5 to 6 ships of APP size to deliver the 700 MMcfd which the NEB has forecast would be consumed in the region by the year 2000. This level of delivery could conceivably require reserves greater than those present at Drake (assuming 1:7300 deliverability) but smaller than those already identified on Melville Island (the Drake and Hecla fields). Some of this production would have to come from offshore wells.

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(b) Alternatives

But if the APP were to be expanded by adding more ships - and why else would it call itself a pilot project? - it must then be evaluated against its alternatives. It is not at all clear that APP gas would constitute the optimal source of new domestic supply by 1997. A Dempster, Mackenzie or Polar Gas "Y" line would each offer the economy of scale of large diameter pipelines (assuming, as we are assured by Panarctic and others, that commercial thresholds will be developed by then). At high throughputs, they would also offer a smaller shrinkage * (19 per cent in the case of the APP of which about 10 per cent would be lost through the shipping component alone). Pipelines would also be better suited to using the existing west to east transmission infrastructure. Hence, superior methods of delivery of Arctic Islands gas may be available. The same can be said about sources of gas to supply the eastern markets.

For the foreseeable future, western gas is likely to remain cheaper than frontier gas, even with the cost of delivery. If a commercial threshold (thought to be 3 Tcf) is established on Sable Island off Nova Scotia - perhaps as early as this year - this supply would almost certainly be developed at a lower cost than APP gas. Newfoundland and Labrador gas would be more expensive to develop than Nova Scotia gas, but probably still cheaper than APP gas. Petro-Canada, it is worth

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* gas lost in transmission

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noting, has a commercial interest in east coast offshore gas as well as High Arctic gas.

Notwithstanding the above, it may be to Canada's advantage to retain the LNG option as one supply alternative in the future for east coast or foreign-produced LNG. If that were the case, and it would be an important policy consideration, a terminal in Quebec would seem to offer greater flexibility of deliveries than those further east proposed by Petro-Canada. As gas demand in new eastern Canadian markets will be concentrated between Quebec City and Montreal, an APP terminal in New Brunswick or Nova Scotia would impose larger pipeline costs than one on the St. Lawrence. It would also force a modification in the proposed Q & M pipeline system. The importance of this consideration would increase as the APP was incremented or Canada received LNG from other sources.

(c) Reliability

The APP would make eastern Canada dependent upon an untested supply of gas. The very nature of the project indicates that the risk of supply interruption will be greater than would be the case with a pipeline.

Petro-Canada estimates that the average round trip from Melville will take as much as 33 days in winter and as little as 16 days in summer. Each ship would be capable of carrying 140,000 m^3 of LNG or 2.965 Bcf of natural gas.

Assuming that the ships would operate year round (i.e., no down time for drydock or servicing), and that their arrivals at a southern terminal were evenly spaced, the Arctic Pilot Project could theoretically achieve a summer throughput of 370 MMcfd (2.965 Bcf divided by 8 days) and a winter throughput of 179 MMcfd (2.965 Bcf divided by 16.5 days).* (In fact, the summer throughput would be lower for two reasons: the liquefaction facilities on Melville are rated at 300 MMcfd and there is not enough storage provided on Melville to allow the ships to call more often.)

These assumptions are optimistic. Petro-Canada plans to leave each of its ships in drydock for 20 days a year. Accidents, unexpected concentrations of multi-year ice, fog and icebergs could delay the carriers. Seasonal delays to avoid biologically important areas. mechanical breakdowns in a stressful environment and problems arising from the application of upgraded technology must also be anticipated. Finally, the ships may have to be completely refitted or replaced during the life of the project.

The APP's season-dependent throughput would make it unique among existing domestic transmission systems. No pipeline faces the same constraint. Indeed, as natural gas demand in winter considerably exceeds summer demand, the APP's throughput would ebb and would be at highest risk precisely when market demand would be at its highest. The opposite problem would occur during the summer as the APP's throughput would peak

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* The numbers in this section are illustrative and meant only to demonstrate the unique problems inherent in this transportation mode.

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when demand was relatively low. In order to even out its delivery pattern and meet its daily contract quantity, the APP would have to provide extensive storage capacity.

The APP proposes to build two LNG storage tanks at its southern terminal capable of holding 200,000 m^3 of LNG or 4.391 Bcf of gas. Assuming that they were full at the beginning of winter, they could be drawn down at the rate of 46 MMcfd (225 sales contract volume minus the winter delivery volume of 179) over a maximum period of 95 days. They would then be replenished during the summer. Assuming a daily throughput of 300 MMcfd which is the maximum possible, this would take at least 58.5 days.

Therefore, is this 200,000 m^3 of storage capacity adequate? It is equivalent to 18.8 days of contracted deliveries and might be sufficient if each ship arrived at the southern terminal at equal intervals. But if only one of the ships became delayed, deliveries would no longer be made on schedule, and a faster drawdown of stored LNG would be necessary. It is such an eventuality which led a study for the Department of Transport to assume that storage capacity should be twice the capacity of the tankers used. (Albery, Pullerits, Dickson and Associates, Marine Transportation of Oil and LNG from Arctic Islands to Southern Markets, 1978).

If the above study is correct in its assumption, APP storage should be increased by 40 per cent to provide 26.3 days of contractual

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deliveries. But even at this higher capacity, Petro-Canada's voyage-time data indicate that there would be four round trips in winter that would take longer than the increased storage would allow for.

If storage capacity is inadequate at the southern terminal, it will be so at the northern terminal as well where identical capacity is proposed. Here the inverse problem would exist. Ship delays would increase LNG storage and might lead to a curtailment of gas production.

The capability of the APP's storage capacity to maintain even gas deliveries in the South and steady production in the North has important environmental ramifications. For example, if the APP delivery schedule is overly optimistic, the APP's contractual obligations to its supplier and its customers would create a pressing incentive to trade environmental protection for a greater throughput. An increase in storage capacity would reduce that incentive.

But even if the APP did provide sufficient storage capacity, it could not be expected to meet the full seasonal fluctuations in demand. Domestic gas demand is on average twice as high in winter as in summer. Additional delivery facilities would therefore be required during the winter months. As these facilities would be used only in winter (as opposed to a pipeline which can be run half-full in summer), they could be expensive to amortize.

A partial solution to this problem would have the APP meet only

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industrial demand which is less subject to seasonal fluctuations. In its February 1979 report, the NEB estimated that industrial demand in expanded markets in eastern Canada would amount to 201 MMcfd in 1985 (including thermal generation in the Atlantic Provinces) and would climb to 376 MMcfd by 2000. (These numbers may be slightly optimistic as the NEB has already revised its gas demand forecast downward.) Because industrial demand is dispersed, however, having the APP meet this market may not be practical.

Finally, the APP could not be used, as LNG is sometimes used in U.S. markets, to supplement other supplies during high demand periods (so called "peak-shaving"), because the LNG throughput would be too great relative to the market it would be serving. It would have to be used as a base load system, or exported directly.

In summary, the connection of the Drake reserves to market cannot be justified on the grounds suggested by Petro-Canada. There is no need for expensive frontier gas in Canada and there appears to be none in the United States, or Petro-Canada would not have proposed to blend its exports with cheaper Alberta gas. There are clearly more viable alternatives available to service eastern Canadian markets and there may also be superior alternatives for moving High Arctic gas. Beyond this, the project by its very nature is of questionable reliability.

2.1.2 Reduction of embargo-related storage costs

Petro-Canada argues that "the export of LNG will improve Canada's

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net energy import position. To the degree that this reduces Canada's obligation, under agreement with the International Energy Agency to store oil against a possible embargo, a cost-saving benefit will be realized."

Under the IEA agreement, Canada is to store the equivalent of 90 days of net *oil* imports. The export of LNG, therefore, would not reduce Canada's obligations and would not affect embargo-related storage costs.

It is possible, of course, that natural gas will be included in a future IEA agreement, but this must be regarded as speculation. (Canada's energy situation illustrates the problems of administering such a system since in 1985 Canada could be a substantial net importer of oil but a net exporter of energy as a result of gas exports. An IEA formula would have to take such disparities into account.)

In any event, it is clear that the APP cannot reduce embargo-related storage costs *directly*. LNG cannot compete now or in the foreseeable future with western gas in backing out oil imports. Even if it could, as the range of substitution between oil and gas is limited in the near term, Canada will still have to store imported oil until it achieves oil self-sufficiency if it is to avoid the disruptive effect of a long embargo.

2.1.3 Positive effect on exploration

By providing Panarctic Oil's first cash flow, the Arctic Pilot

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Project should stimulate exploration in the High Arctic. Petro-Canada estimates the value of natural gas at Bridport Inlet at $2.70 per Mcf in 1984 (likely to be higher because of greater-than-forecast inflation). Curiously, although Petro-Canada gives separate cost estimates for transportation and vapourization, it does not isolate the Melville costs in liquefaction, pipelining and netback to Panarctic.* Although the development costs of drilling two clusters of 4 wells each and processing the gas should not be too high (the gas is sweet and dry), it is difficult to ascertain whether the $2.70 per Mcf FOB at Melville will be sufficient to cover all costs on the island and also stimualte much greater exploration. It can be expected that the APP's high transportation costs would exert a substantial downward pressure on Panarctic's netback. Also, the risk that this "pilot" project may run into difficulties and cost more than anticipated cannot be ignored.

If we assume arbitrarily that Panarctic would receive a netback of $1.50 per Mcf (which is what the Mackenzie Delta producers had said they needed), the Pilot Project would generate revenues in the order of $136 million a year at projected rates of production. This is roughly four times more than what Panarctic is currently spending in exploration. Allowing for a return of production costs and a return on equity, this cash flow should accelerate exploration in the Arctic Islands. If the producing wells on Melville were included with all other producing

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*This is all the more curious since Petro-Canada is Panarctic's major shareholder and the Pilot Project will therefore be providing a netback to Petro-Canada itself.

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gas wells in Canada as being entitled to an export price flowback (perhaps not an unreasonable assumption since the APP will export gas from Alberta as well), the revenue accruing to Panarctic would be much greater still. These sums, if appropriately channelled, would obviously produce a real boom in exploration and development in the High Arctic, which should stimulate a greater rate of reserve addition.

In the absence of additional information, however, it is impossible at this time to estimate by how much the APP would stimulate arctic exploration.

2.1.4 Improved knowledge of the producibility of arctic reservoirs

This benefit will indeed result from the Arctic Pilot Project – certainly in the case of the Drake field. The importance of this improved knowledge, however, is questionable. Certainly, Panarctic has never expressed doubts over the producibility of Arctic Islands reservoirs. In its submission to the 1978 NEB gas hearings, Panarctic stated that "the geology of the Arctic Islands is relatively simple and reservoirs are consistent so that high density drilling is not required to give adequate proof of reserves." Panarctic added: "The wells drilled to date which have encountered natural gas reserves have demonstrated high deliverability which will aid the economics of production and permit high percentage recoveries from the reservoirs."*

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* Panarctic Oils, Submission of Panarctic Oils Ltd., before the National Energy Board's Natural Gas Supply and Requirements Hearing 1978 (Calgary, 1978), pp.2-3,4.

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Most of the arctic reservoirs discovered to date lie offshore. Indeed, Petro-Canada at one time intended, as part of the Arctic Pilot Project, to determine the feasibility and operational effectiveness of offshore production and subsea pipelining. This objective has now been abandoned without explanation. It would be valuable to build upon the experience acquired through the previous successful completion of the Drake F-76 offshore well to prove the technical feasibility and economics of production wells farther from shore. This would become necessary, of course, if the APP were substantially incremented.

In conclusion, the Arctic Pilot Project's contribution to Canadian energy security of supply is likely to stem principally from its stimulative effect on reserve additions. To the extent that the APP demonstrated the technical feasibility of delivering Arctic Islands gas by LNG carrier, it could also be argued that its mere existence would be of value from a security of supply standpoint — even if it served no Canadian market. This argument would be based on the premise that it would be easier to increment or replicate an existing project than to undertake a completely new transportation system. It is difficult, however, to assess the value of this benefit. It would be non-existent in the case of a sudden oil embargo since the lead time in building another ship would be too great. Similarly, if pipelines were to be demonstrated as superior to LNG carriers for the delivery of arctic gas to domestic markets, the advantages of proceeding with the APP from an energy policy point of view would be reduced, if not negated.

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2.2 Exports

The APP had originally proposed to export by displacement approximately 1.9 Tcf of gas over 20.5 years. Under this scheme, Melville Island gas would have backed out western gas dedicated to the eastern market. The western gas would then have been freed for export to the U.S., possibly through the Alaska Highway pipeline.

More recently, the APP has considered doubling its export commitment by blending the original volumes at LNG prices with equivalent volumes at the existing border price. Before the NEB gas export hearing last year, Petro-Canada argued:

> such additional volume would bring the average unit cost of the combined gas from both of these sources down to a level which could be more readily accommodated in the American market and provide U.S. customers with the added inducement of a larger volume of gas than can be made available through the Arctic Pilot Project alone.*

The APP's proposal to export almost 4 Tcf of gas raises four distinct issues: the policy implications of long-term exports; the surplus test to be used in ruling on these exports;the concept of export through displacement;the merits of blending APP exports with additional western exports.

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* D.M. Wolcott, Intervention of Petro-Canada, Direct testimony before the National Energy Board, 3 July 1979, p. 10.

2.2.1 Policy implications of long-term exports

In its application, Petro-Canada argues that the "marketability of Arctic Islands natural gas will be enhanced by several non price factors which ... will ... be extremely attractive to American regulatory authorities." Perhaps the most important of these factors: "By providing an outlet for Arctic Islands gas, the United States will be helping to ensure that exploratory activity is maintained in frontier regions. This activity can make an important contribution to the long term energy future of North America."

The dynamic to which Petro-Canada hints in this statement poses a potential risk to Canada. Will future exploratory success in the High Arctic, attributable in part to the cash flow generated by the Pilot Project, lead to further export applications? Is there a risk that some of the most accessible reserves of the Sverdrup Basin — those on Melville Island — could become dedicated (albeit by displacement) to American markets because they are more expensive than western gas and therefore "surplus" to presently forecast Canadian needs? As it is unlikely that High Arctic gas will find a market in Canada before the turn of the century, simply because it is so costly compared to other domestic sources, a long-term export obligation is not an altogether impossible eventuality and could have severe implications for the Polar Gas pipeline which also proposes to connect Arctic Islands natural gas to markets in the South.

In other words, is the Arctic Pilot Project a Trojan Horse which, under the cloak of asserting Canadian sovereignty in the North, would in fact lead to a pre-emptive appropriation of arctic gas reserves for

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American use? This is a highly speculative question which is not meant to inpugn Petro-Canada's motives. We must recognize, however, that resource development answering to the maximization of profit — a drive that applies to Panarctic, Alberta Gas Trunk Line, Melville Shipping, and also perhaps Petro-Canada in this case — answers to its own internal dynamic which can be summarized simply as: produce as much as possible as quickly as possible. Since the capital systems necessary to make the APP and its increments economic would have to be amortized over a long period of time, the risk that this dynamic may pre-empt future policy options cannot be ignored.

A new Canadian commitment to long-term gas exports would ignore the events of the last decade. The risks inherent in such a policy were revealed in the apprehended shortages and the threat of domestic rationing in the mid-70s. In spite of the startling improved prognosis of western gas deliverability — or perhaps because of it — the NEB has adopted a more restrictive export policy based on the deliverability of established reserves rather than forecast reserve additions. As some controversy still exists about the size and quality of the undiscovered potential of the western sedimentary basin, it would be imprudent for Canada to reverse its new export policy and commit itself to the sale of another 4 Tcf of western gas to the United States. One only has to review the events of the last 20 years — the same length of time as the APP's amortization period — to realize how difficult it is to anticipate and plan for contingencies in the energy field.

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2.2.2 Surplus test

The export of arctic gas raises the question of how Melville gas should be treated. It has never before been included by the NEB in its definition of Canadian supply since it has never been and is still not within economic reach. If it were included now, for the purpose of this application, it would increase the calculated Canadian surplus.

A declaration of an increased "surplus" would not likely be in the national interest if it were to result in higher exports of Alberta gas and if it forced future domestic consumers to rely to a greater extent on more expensive arctic gas for which no adequate transportation infrastructure exists.

It is apparent, therefore, that High Arctic gas should be treated differently from conventional gas. If so, how much do we decide to export? Should we consider only the reserves at Drake? Should we include the adjacent Hecla field? Should we include all the reserves that have already been identified in the High Arctic?

Petro-Canada contends in its application that it is "eminently reasonable" to dedicate 25 per cent of the proven reserves on Melville to the export market. Perhaps it is, but at this stage such a scheme is arbitrary and self-serving.

There is no procedure through which one can evaluate, within the context of national energy objectives, how much Canada should export from

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the Arctic. Yet this question must be addressed in order to evaluate the implications of the present application. Fundamental to any analysis would be a comparison of pipelines (e.g., Polar Gas) with LNG ships. Such a comparative study was promised by the Minister of Transport in August 1976, but has not yet been undertaken. Although approval of the APP would make ships the first transportation mode for the marketing of Canadian arctic gas, it does not follow that it will be the optimal one from a domestic point of view.

2.2.3 Exports through displacement

Petro-Canada prefers to export Melville Island gas by displacement "to open the door to many markets and not be restricted to one." As was outlined in earlier sections:

(1) this scheme could mean the dedication of up to 450 MMcfd of western gas to the U.S. for 20.5 years and the partial reliance of eastern Canada on APP gas;

(2) the APP delivery system is unlikely to be as reliable as an extension to existing pipelines;

(3) the APP is not suited to meet the seasonal fluctuations in demand in an economic manner; and

(4) the APP may delay the development of cheaper gas reserves (e.g.,Sable Island).

All four factors indicate that from a Canadian standpoint, APP gas should be exported directly at its true cost (if it is found to be

surplus) rather than through "displacement" and "blending". Nevertheless, the benefits of building an LNG terminal in Canada rather than the U.S. (industrial and energy policy benefits of maintaining this option) probably outweigh the costs (principally safety).

One should note also that if the APP adds more ships before a domestic market has been developed for Melville gas, the additional gas volumes would probably have to be exported directly anyway since there would no longer be enough excess deliverability in western Canada to permit exports through displacement.

2.2.4 Blended exports

The APP's recent proposal to blend exports at LNG prices with exports at regular border prices implies that there is no market for Melville Island gas in the United States. It also raises a question about the accuracy of the cost estimates in the APP application.

In the APP's cost-benefit analysis, the cost of delivering Melville gas to a pipeline on the St. Lawrence is calculated at $5.51 per Mcf in 1984 dollars. Deflating this figure to 1977 (the base year in the APP analysis) by the inflation rates assumed by the APP and inflating it again to 1980 to reflect the actual (higher) inflation of the last two years, the cost of APP gas at a St. Lawrence terminal tailgate becomes approximately $5.00 per Mcf. This is not substantially higher than the new export price of $4.47 per Mcf. As it is probable that the export price will rise in real terms, the 12 per cent difference between the

border price and the cost of LNG leads one to ask why the APP considers it necessary to blend its export. In fact, blending may no longer be needed since it was proposed before the last export price increase (29 per cent). If it is still needed, one can only conclude that the figures in the cost-benefit analysis are understated and must be readjusted upwards.

The size of the latest export proposal raises questions as well. It is not at all clear that the APP will succeed in convincing the NEB this year or next that enough excess deliverability exists in Alberta to permit an additional 225 MMcfd of exports starting in 1986. This is particularly so in the aftermath of the NEB's approval of a 40 per cent increase in Canadian gas exports which depleted almost the entire exportable surplus. Furthermore, the APP will have to compete against other export applicants in demonstrating the existence of a new exportable surplus.

This is not to say that the present record-setting pace of exploration and development may not yield a deliverability "bubble" in western Canada in excess of domestic requirements by the mid-80s. This excess deliverability, however, is likely to be short-lived as trend analysis indicates that the effort required to find marginal volumes of gas is increasing. It is therefore extremely unlikely that Canada has a long-term surplus of western gas as suggested by the Pilot Project.

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2.3 Conclusion

The Arctic Pilot Project seems to be of dubious benefit to Canada from an energy standpoint. Specifically:

(1) It will high-grade the reserves on Melville.

(2) It will expose eastern Canadian consumers to a greater risk of supply interruption than they would be exposed to otherwise.

(3) Its stimulus to High Arctic exploration must remain speculative in the absence of an estimate of the netback Panarctic would recieve.

(4) It would commit Canada to the long-term export of some of its cheapest and most accessible gas (in western Canada) and increase Canadian dependence on more expensive frontier gas.

If the APP were to be judged purely on the basis of its contribution to Canadian energy objectives, there is little question that it would be rejected. Properly modified, however, the APP could be made more attractive. If, for example, the project were to export directly rather than through displacement, several of the concerns discussed above would be assuaged. If, in addition, the project were to rely on a different gas supply — say, King Christian Island rather than Melville Island — it would no longer pose the risk of foreclosing the option of a future pipeline.

The project would then contribute very little to domestic energy policies but it would at least no longer detract from their optimal implementation. The APP would in effect become a commercial venture whose

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most important feature would be its pioneering of year-round arctic navigation and its establishment of substantial arctic technological excellence in Canada. It is to these implications of the project that we now turn.

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3. PILOT FOR WHAT?

Petro-Canada has stressed repeatedly the "pilot" nature of its proposal to move gas from the Arctic. It has claimed, quite correctly, that the APP would test the technical and economic feasibility of moving arctic resources by the marine mode on a year-round basis. The APP, however, is not a "pilot" as that word is commonly understood. Costing $2 billion and involving 20-year contractual commitments, the project will not be changed or abandoned easily if significant technical, economic or environmental problems arise. It is true that all major developments in the North break some new ground and provide new challenges and learning experiences. However, it has never been suggested that we consider an Arvik "pilot" mine, a Foothills "pilot" pipeline, or a Dempster "pilot" highway.

If approved, the APP will represent a permanent commitment in its own right. The only question its sponsors will debate will be whether to increment it at a later date by adding more ships and facilities.

The APP's true pilot nature lies in the development it may precipitate or bring forward in time. As the first year-round commercial marine venture in the Arctic, the APP will facilitate others in the same way any pioneering venture tends to do. The assessment, approval, and the terms and conditions for this first arctic marine transportation system will thus establish the framework for all that follow.

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The APP must therefore be analyzed within the context it will help to establish. The following discussion will address three main topics: marine traffic, regional growth, and industrial, technical and sovereignty factors.

3.1 Marine Traffic

3.1.1 The establishment of a marine corridor

A successful Arctic Pilot Project will encourage other shipping ventures in the North. These ventures will undoubtedly attempt to replicate the successful aspects of the Arctic Pilot Project. Basic to success is routing. If the APP's proposed routing is proved successful, others will quite rightly expect to follow similar paths and be subject to similar terms and conditions. Shipping corridors will thus become established.

At present, arctic marine transportation in Canada is limited to the summer months. Shipping involves community and industrial resupply, scientific research, Canadian Coast Guard and Department of National Defence operations, and the movement of mineral resources. The only commercial bulk carrier operates in the summer to remove lead-zinc concentrate from Strathcona Sound on northern Baffin Island.

Several developments are proposed that will significantly alter the nature of this shipping. The locations involved in these proposals range across the Arctic from Alaska to Baffin Island. The actual

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fruition of these projects will depend upon a variety of factors; however, in order to obtain an estimate of probable future traffic (transits per year through the eastern part of the Northwest Passage), we have examined the projects which may come on stream within the next 20 years and projected the traffic densities they would create. (The details of these projects and their shipping requirements are given in the Appendix.)

The present proposals to move Alaskan North Slope oil, Beaufort Sea oil, Arctic Islands hydrocarbons, together with the shipping from existing, approved and anticipated mining ventures and a modest increase in resupply and related operations, could produce about 1000 transits a year by the year 2000, of which about 850 would probably be on a year-round basis. That would work out to a yearly average of one ship approximately every ten hours.

Whatever the actual numbers, there can be little question that a marine transportation corridor through the Northwest Passage will be established. In assessing the environmental effects of the Arctic Pilot Project, it is necessary therefore to anticipate the traffic that will follow, as the route the APP maintains and the navigational and other systems it establishes will create the shipping corridor for others.

3.1.2 Routing and environmental matters

Petro-Canada plans to transit the Northwest Passage from Melville

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Island, to cross Baffin Bay, to follow the west coast of Greenland into Davis Strait and the Labrador Sea, and to proceed to an eastern Canadian terminal. The exact routing will vary according to the seasons and to regional ice conditions so that the ships can take advantage of areas of thin ice, leads and open water where they exist. The ships, however, will also have to contend with difficult ice conditions, areas of high iceberg densities, storms and fog. Their routing will carry them through some of the Arctic's most biologically productive habitat-areas that are important for Inuit hunting in Canada and Greenland. In this sense, ice must be considered as more than just an obstacle to be overcome, and leads and open water must be recognized as much more than just easy sailing to be exploited.

3.1.2.1 Ecological background

The ecologically important segments of the APP shipping corridor appear to be Lancaster Sound, northern and eastern Baffin Bay and eastern Davis Strait.*

Lancaster Sound is important as a migratory route for marine mammals and as an area for seabird feeding and breeding. Its early open waters,

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* This overlooks the Viscount Melville Sound which is affected somewhat by the project. It is worth noting that subsequent to the 21 September 1977 meeting of the Interdepartmental Environmental Review Committee, Viscount Melville Sound was categorized, for the purposes of exploratory drilling, as an area where no activity was to proceed because of its environmental sensitivity. The signficance of this and the implications for the Arctic Pilot Project are unknown.

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which clear in advance of other eastern High Arctic waters, make it the only route open to migrating mammals in the late spring and early summer, and is the key factor in seabird survival in the early spring. Lancaster Sound is regarded as being of special biological importance in the eastern Canadian Arctic - a fact that led to the postponement of exploratory drilling there in 1979 and preparation of a Green Paper for the region by the Department of Indian Affairs and Northern Development. However, important as it is, the sound is a small component of a considerably larger ecological unit including Baffin Bay and Davis Strait.

According to Petro-Canada: "The unique physical environment of Baffin Bay and Davis Strait results in conditions conducive to higher levels of marine productivity than any other regions of the eastern Canadian Arctic." The distribution of marine mammals and seabirds is highly dependent upon open water and ice conditions. Largely due to phenomena such as the Greenland current, areas of open water exist in northern Baffin Bay (the North Water) and eastern Davis Strait throughout the winter. These areas, in particular Davis Strait, are wintering grounds for many forms of both arctic and subarctic marine life: narwhal, beluga and bowhead whales, walrus, various species of seals, and numerous species of arctic and North Atlantic seabirds. Like Lancaster Sound, the western Greenland coast, because of its ice conditions, open leads and early clearing, is also an important route for marine mammals and seabirds. The same coastal stretch is also an important hunting area for Greenland Inuit. It is these same areas which fall within the Arctic Pilot Project's shipping corridor (see Figure 1).

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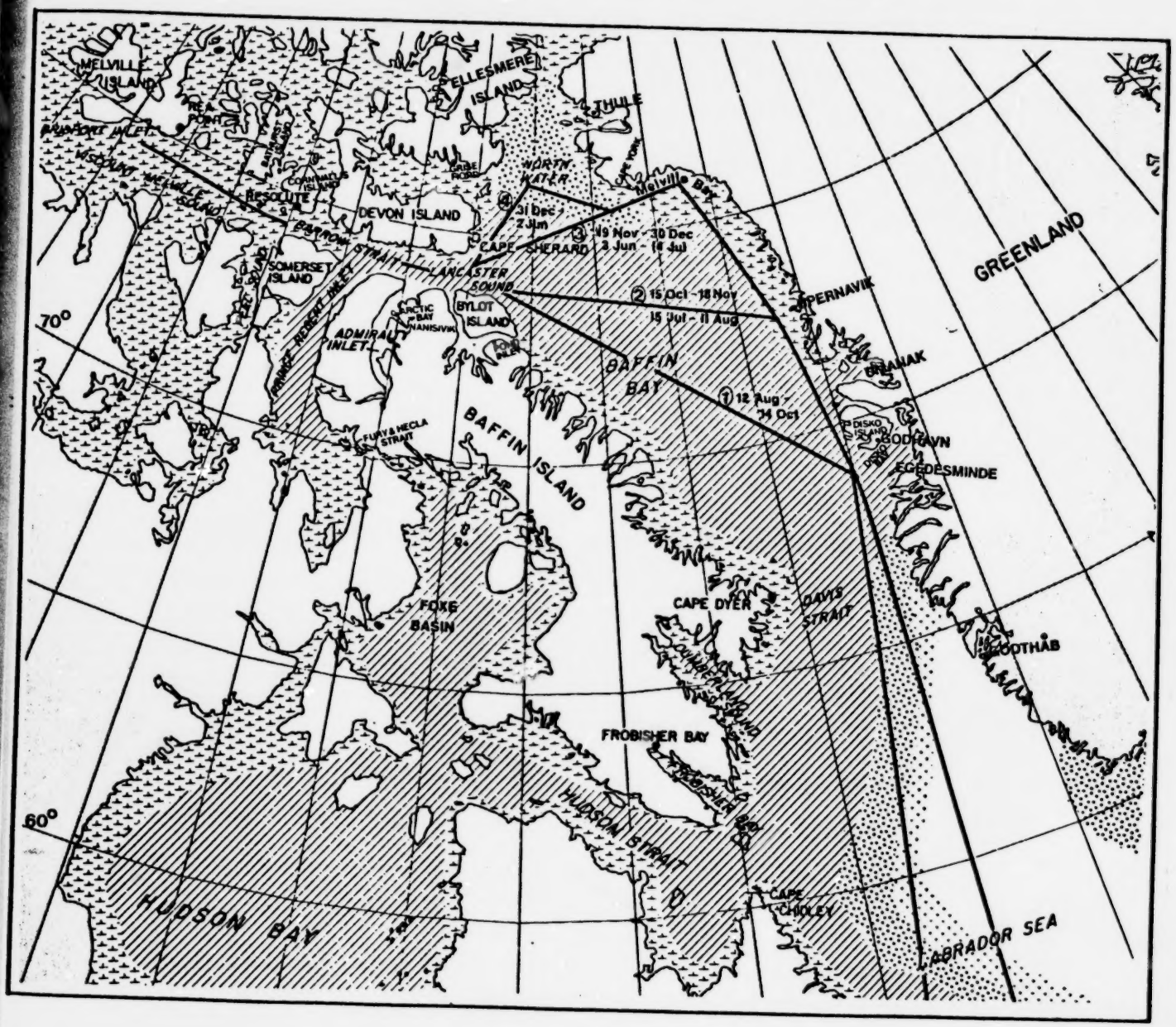
FIGURE 1

PROPOSED LNG CARRIER ROUTES AND WINTER ICE CONDITIONS



Average Ice Conditions
at Maximum Extent (March)

LEGEND

- 10/10 FAST ICE
- 8/10 TO 9/10 CLOSE ICE
- 5/10 TO 7/10 BROKEN ICE
- 1/10 TO 4/10 SCATTERED ICE
- < 1/10 OPEN WATER

LNG Carrier Routes ——————

Potential disruptions of the marine environment caused by carrier traffic have been acknowledged by Petro-Canada, although their extent is unknown. Petro-Canada believes that carrier traffic in eastern Parry Channel will not significantly alter local break-up patterns. It believes, for example, that any break-up resulting from activities of the LNG carriers in Barrow Strait would probably be within the range of natural fluctuations. No information is provided on what those natural fluctuations are. Similarly, Petro-Canada expects the effects of carrier traffic noise on marine mammals and seabirds to be minor, although it admits that more information is required to quantify the cumulative effects. The company also acknowledges the problem of marine mammal entrapment in open leads caused by ice breaking but cannot define it precisely at present.

3.1.2.2 Ice regime, icebergs and route selection

The above biologically productive waters are the proposed shipping corridors for the LNG carriers. The choice of those corridors is based to a large extent on regional ice conditions. Petro-Canada has apparently chosen routes which exploit areas of open water and thinnest ice in order to reduce fuel consumption and increase speed (see Figure 1). In the winter (mid-November to early June) the carriers intend to exploit the open waters of eastern Davis Strait and then hug the shorefast ice along the coast of Greenland from Umanak to Cape York and into the North Water and over to Lancaster Sound. In the sound and Parry Channel, the ships will exploit the zone of weakest ice, which is usually along the zone of the shorefast sea-ice interface.

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Alternate summer routings will cross Baffin Bay in a more direct way from Greenland to Lancaster Sound.

However, the ice regime and other data presented by Petro-Canada are so general or selective that it is difficult to evaluate the chosen route or to assess only alternatives that may be preferable for environmental, social or political reasons. The Class 7 ships the APP will use will be capable of going through virtually any ice conditions known in the region. There is no physical reason why in Baffin Bay, for example, the ships could not avoid sensitive areas along the Greenland coast. Although a narrower area, the Parry Channel also offers a choice of possible routings. None of these have been addressed by Petro-Canada.

Icebergs must also be considered in routing since they are prevalent all along the route (depending on the season) from the Grand Banks of Newfoundland to Barrow Strait. There are fifteen major iceberg-producing glaciers located between Disko Bay and Cape York along the western Greenland coast and five more are located further north in the North Water region. The annual output of western Greenland glaciers is estimated at 10-15 thousand icebergs, with calving occuring year-round. Other icebergs present in Baffin Bay originate in eastern Greenland and on Ellesmere, Devon and Bylot islands. As many as 40,000 or more icebergs may be present in Baffin Bay in one year. These icebergs will provide a significant navigational hazard throughout the perimeter areas of Baffin Bay.

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Petro-Canada states that as far as the Arctic Pilot Project is concerned, icebergs are the most important aspect of the physical environment of Baffin Bay and Davis Strait next to sea ice conditions. However, as with the ice-cover data, iceberg data also seem tenuous. For example, Petro-Canada's figure 5-17 showing summer iceberg distribution appears to be based on an August 1949 count by the United States Coast Guard. In its May 1979 report - Preliminary Risk Analysis; LNG Carrier System; Arctic Pilot Project - Petro-Canada consultant Arctec Canada points out that "existing iceberg data is sparse and not always in a readily usable format. Present iceberg counts provide a uniform density but do not provide an accurate spatial distribution of icebergs." Petro-Canada says in its application that icebergs are of major concern because they make unreliable radar targets and can therefore render navigation hazardous under certain conditions of restricted visibility. The problem of detecting icebergs in the Arctic becomes acute during fog conditions* - conditions which will be prevalent along much of the proposed route.** To solve this problem, Petro-Canada is proposing the use of sophisticated detection equipment systems that will only be tested in the summer of 1980.

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* See, for example: Canadian Coast Guard, Ice Navigation in Canadian Waters (Ottawa:1977), pp. 12-13; Albery, Pullerits, Dickson & Associates, Marine Transportation of Oil & LNG from Arctic Islands to Southern Markets; Main Report, prepared for Strategic Studies Branch, Transport Canada, (Don Mills, Ont., March 1978), pp.5-4, 5-5, 5-6.

** See Table 5-1 in Albery et al., Marine Transportation; Appendix B; and Petro-Canada's application, Environmental Statement; Shipping Component (January 1979), pp. 5-5, 5-37.

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In summary, the proposed routing appears to be rather poorly supported. Historical and seasonal data on ice thickness are lacking. Icebergs are acknowledged as posing a problem, although information on them is also sparse. Iceberg detection is recognized as being difficult. Yet the chosen route passes through areas of high iceberg density, poor weather and, in many cases, great biological importance.

These routing concerns strike at the very heart of the Petro-Canada proposal for a shipping corridor. Nowhere are alternative corridors discussed. Various corridors through Parry Channel and Baffin Bay are feasible, but have not been studied, even though they may be preferable from an environmental point of view. Major route alternatives such as one that would avoid Lancaster Sound and the Greenland coast by using Prince Regent Inlet, Fury and Hecla Strait and Foxe Basin appear to be viable, yet they are not dealt with in the proposal.

In part two of this submission it was suggested that King Christian Island would be a more appropriate source of gas than Melville Island for an arctic "pilot" project. Indeed, Petro-Canada has undertaken a conceptual study for such a source, although it has not released its results.* However, from a routing point of view the

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* In August 1979 the project manager for the Arctic Pilot Project advised CARC that such a study was underway involving four consulting firms: Arctec Canada Ltd., German and Milne Ltd., Albery, Pullerits, Dickson and Associates Ltd.,and Genstar-Wardrop. The object of the study was to compare the technical and economic viability of more northern sites with Melville Island.

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comments of Dome Petroleum's director of marine research and design at the 1977 seminar on Natural Gas from the Arctic by Marine Mode are worth quoting:

> Actually, if I were responsible for year-round LNG operations in the Arctic, I would demand 180,000 - 200,000 shaft horsepower installed in ships going to King Christian Island as well as Freeman's Cove [on the south coast of Bathurst Island to the *east* of Melville Island] because ice conditions are really not that different in difficulty. Going to King Christian Island, there is somewhat thicker one-year ice and more multi-year ice, but for most of the year, and especially when the ice is thick, it is stationary and it is possible both to avoid the worst ice and make use of the same channels over and over again. Thus, the risk of getting into extremely difficult conditions is considerably greater when going to Freeman's Cove than to King Christian Island.*

3.1.2.3 Inuit resource use and routing

Interrelated with vessel routings and ecological considerations are the effects of carrier passage on Inuit resource use. LNG carriers will pass through important hunting areas: Lancaster Sound, Barrow Strait and the Greenlandic coast from Thule to Umanak.

Inuit concern about the effects of year-round shipping is well known. Recently it was raised at community meetings in Resolute (28 October 1979) and Arctic Bay (25,26 October 1979) and in an

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* The Science Council of Canada and The Atlantic Provinces Economic Council, Proceedings of the Seminar on Natural Gas from the Arctic by Marine Mode: A Preliminary Assessment (1977), pp. 83-84.

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official statement in the Greenland newspaper Hainang (5 October 1979).* Greenlanders have confronted the threat to hunting posed by ice-breakers before. In 1975, hunters stopped the icebreaker "Sigyn" in western Greenland and forced an expensive routing change for the company moving lead-zinc from the Black Angel mine.**

These concerns are important because they relate to the very underpinnings of much of Inuit culture and life. Petro-Canada has recognized that the project may affect income and income-in-kind by disrupting Inuit hunting and trapping. However, the assurance that compensation will be provided for income loss resulting from "direct project impact" will be unworkable. Establishing a "value" will be virtually impossible as will determination of the extent of direct project impact on migratory species that are used throughout the eastern Arctic (including Hudson Strait) and Greenland.

It is unreasonable to expect that the Inuit should assume any portion of the risk to their livelihood. It is Petro-Canada, not the Inuit, which should bear the burden of proof, the risk, and ultimately the economic cost.

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* For a translation of this statement see: "Statement from Thule's Municipal Council Concerning the Passage of Canadian LNG Tankers Through Greenland's Waters," Northern Perspectives, vol. 7, no. 8 (1979): 4.

** O. Quist, "Hunters Stop Icebreaker," Politiken (27 May 1975), in Canada, DIAND, Information and Liaison Division, Press Clippings on Greenland, no. 16, p. 10.

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There is a need to re-examine the laws related to damages so that they deal properly with possible interference with wildlife resources and related human activities. Legislation in the United States that is of particular relevence in this regard is the Trans-Alaska Pipeline Authorization Act which set an important precedent for environmental and economic compensation. In fact it is much more responsive to the kinds of problems that could result from the APP than is Canadian legislation (such as the Canada Shipping Act and the Fisheries Act). Unlike Canadian law,the U.S. legislation departs from "a narrow common law notion of damages which precludes recovery where the loss flows from interference with natural resources like fish or marine mammals." Damages in the act have been described as:

> any economic loss resulting from an oil spill including, among other things, loss of use of real or personal property or natural resources; injury to, or destruction of natural resources; loss of profits or impairment of earning capacity due to injury or destruction of property or natural resources, including loss of subsistence hunting, fishing, and gathering opportunities, and loss of tax revenue for a period of one year due to injury to real or personal property.*

Clearly, these same considerations must be borne in mind when considering terms and conditions for shipping in our North.

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* A.R. Thompson (Commissioner), West Coast Oil Ports Inquiry; Statement of Proceedings (Vancouver, February 1978), pp. 145-146.

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3.1.2.4 Environmental protection legislation

A variety of environmentally-related legislation has evolved in Canada and will affect, in one way or another, decisions about the development and operation of year-round shipping in the High Arctic. Much of this legislation, although critical to the Arctic Pilot Project, is not adequately dealt with in the Petro-Canada materials filed to date. It is, however, important for project evaluation and for developing terms and conditions that could be applied if the project were to proceed. Since the discussion of this legislation is lengthy and almost a subject in itself, it is perhaps best to simply refer to A. Lucas, et al., "Regulation of High Arctic Development" in Marine Transportation and High Arctic Development: Policy Framework and Priorities (CARC, 1979). Also of interest when examining the adequacy of existing legislation on shipping are the proceedings of the West Coast Oil Ports Inquiry.*

Canadian legislation may not be adequate to cover the wide variety of problems that year-round arctic shipping will cause. For example, although a Canada-Denmark Marine Pollution Contingency Plan exists as of 11 July 1979, there are ongoing talks covering a wide variety of outstanding matters related to the marine environment.

It is apparent that the possibility of year-round shipping in the

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* Ibid., pp. 126-150.

Arctic brings with it the need for a review of existing legislation in order to provide ammendments or new acts that will be adequate to control operations, protect the environment and assure northern people in Canada and elsewhere that their livelihood will be properly protected in the event of an accident.

3.1.2.5 Summary of routing and environmental matters

In its attempt to exploit open water and thinnest ice, the APP will find itself in one of the world's most iceberg-infested waters. The routing also proceeds through a region that has highly unpredictable weather, heavy fog conditions and marine areas that are, for many of the same reasons which make them desirable for shipping, ecologically exceptional and vital to the Inuit populations in both Canada and Greenland.

Although the available data are obviously sparse, it is likely that alternative routes exist which are more preferable environmentally, socio-economically and politically, and are within the technical capability of the Class 7 vessels proposed. For example, the relative costs and impacts of the longer and environmentally more significant winter coastal route in Baffin Bay should be properly compared to a more direct route through (marginally) heavier ice conditions in central Baffin Bay. Petro-Canada claims, on the basis of its ARCTRANS computer programme that such a routing change would increase fuel consumption and hence increase project costs. Petro-Canada, however, has not released the analysis which led to this conclusion.

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Two things can be surmised about this ARCTRANS "black-box" approach. First, the data used to feed the program appears to be of questionable reliability. Based on everything presented to date, it is certainly not comprehensive enough to ensure that the preferred and various alternative routes have been, or could be, rigorously evaluated. The best available information - that gained by the operation of the Manhattan - has not been used. Second, the method of computing is unknown. There is no indication of what is assessed and of how various factors are used. The mathematical technique used is not known. This warrants very careful examination and adds some weight to the argument that routing of the ships could, and perhaps even should be changed to accommodate environmental and other factors.

It should be recognized:

(1) that the Pilot Project, despite its name, is a 20-year, two billion dollar, full-scale venture that is highly unlikely to be abandoned;
(2) that the Pilot Project will set a precedent for the establishment of a highly-used shipping corridor; and
(3) that the Pilot Project will employ ships with the capability of traversing just about any ice condition that might exist south of 75^{o} N latitude.

Wherever alternatives exist, the routing of the project should be required to avoid areas of biological importance and Inuit hunting areas.

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Petro-Canada should be required to substantiate its claim that there are technological-economic penalties inherent in the various alternate corridors from Viscount Melville Sound to the North Atlantic so that they can be weighed against social, political and environmental factors.

3.2 Regional Growth

The Arctic Pilot Project's socio-economic statement focuses on many areas of potential impact: employment, income, transportation, communication, health, municipal services, law enforcement and migration. The statement identifies employment and income as key areas of impact, but its overriding concern appears to be that of population redistribution. It recognizes that some degree of impact will be experienced in each area of consideration but it concludes that the overall impact will be negligable, and that in some instances important benefits will result (e.g., communication and transportation). Petro-Canada believes that with proper corporate planning and strategy, many adverse effects can be minimized, if not allayed completely.

These conclusions are based on information that is admittedly incomplete. Although the statement analyzes the project's impact in the present socio-economic setting, it appears to do so in isolation from other industrial forces, and it neglects the long-term implications of establishing a second major regional base in the High Arctic.

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3.2.1 Long-term effects of establishing Bridport Inlet

Petro-Canada's assessment of the long-term effects of developing a small community on Melville Island is deficient. The company believes that because of the project's remote location, because it has no plans to develop a permanent community, and because of its policy to minimize its relocation incentives, the community will exist in isolation. This rather myopic view assumes no spin-off effects in the form of community development. Petro-Canada has therefore made no plans for community expansion nor has it considered any contingency measures in the event that Bridport Inlet becomes a focal point for industrial development in the western High Arctic.

It is likely that the establishment of a community and associated transportation and communication facilities at Bridport Inlet will lead to the establishment of a regional centre for development. The establishment of a Code Letter B airstrip, for example, can be expected to facilitate development. As Petro-Canada acknowledges, the establishment of such an airstrip would fulfil Transport Canada's wish for a second High Arctic air base in a weather pattern different from the one at Resolute.* With the scale of activities forecast over the next 20 years, the facilities at Bridport Inlet would become a logical centre of industrial air trans-shipment and supply.

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* This need was recognized at the 1970 Arctic Transportation Conference. See G.L. Bartsch, "Arctic Aviation Facilities," in Proceedings of the Arctic Transportation Conference, vol. 2, pp. 71-84 (Yellowknife, N.W.T., 1970).

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The development of port facilities at Bridport Inlet would similarly encourage industrial development. Arctic Islands oil and gas exploration and the development of production gas wells associated with the Arctic Pilot Project and the Polar Gas pipeline (among others) would make Bridport Inlet the likely receiving centre for supplies and materials.

The 93 square kilometres of protected harbour with an average depth of 50-100 metres could easily accommodate and winter Dome Petroleum's entire Beaufort Sea drilling fleet (if Dome is permitted to conduct offshore exploratory drilling by ship on acreage acquired in 1979 in Viscount Melville Sound). If commercial quantities of hydrocarbons were discovered in the sound and put into production, Bridport Inlet could be a logical centre for the development of production facilities, as well as a centre for the storage and loading of hydrocarbons. Also, should year-round marine transportation through the Northwest Passage become a regular occurrence, the Canadian Coast Guard may see fit to establish a base or permanently station an ice-breaking vessel at Bridport Inlet. Similarly, other vessels involved in such activities as scientific research would probably use the port facilities.

As part of all these uses of Bridport Inlet, accommodation facilities and all the services associated with the housing and support of large numbers of people on a transitional or permanent basis would have to be established.

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Throughout the impact statement Petro-Canada stresses the potential problems of population redistribution for local communities and existing services, but concludes: "Population redistribution resulting from the project will cause a negligible short-term impact on community services." Elsewhere, Petro-Canada states: "It is difficult to assess the likelihood of population redistribution among high Arctic communities resulting from the Arctic Pilot Project." The company admits that data gaps remain in many areas.

The ramifications of these developments on the native people's desire and ability to participate and exert control over land and resources will be significant. However, these aspects are not dealt with in the documents provided to date.

Some of the anticipated problems can, as Petro-Canada claims, be solved through corporate policies and planning (after the project is approved). However, without proper data, appropriate policies will be difficult to formulate - let alone implement - either by the company or the government.

To summarize, Petro-Canada's assumption that the development of Bridport Inlet will have no long-term implications for the region is open to question. The potential for development of other projects in the area is large enough to warrant serious consideration of the long-term effects of establishing a second High Arctic centre. Unless consideration begins now and plans are laid for the future, previous

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patterns of *ad hoc* development will persist. Although initial project planning is Petro-Canada's responsibility, the regional planning necessary to place it in context is the responsibility of government. To date there is no apparent move by government to develop such a planning framework.

3.2.2 Employment

The policy of Petro-Canada "is to hire northern residents on a preferential basis and to train northern residents so they may acquire requisite skills." Petro-Canada says that "...this policy would bring important short-term benefits in terms of increased incomes of high Arctic residents during project construction and *perhaps* long-term benefits *if* residents can be employed during the operation phase" (emphasis added).

The employment opportunities provided by the APP could be significant during the construction phase. Of the total number of jobs to be created during the construction stage, 36 per cent could be filled by the local people. Experience elsewhere has indicated that only a fraction of that potential may be achieved. However, one must be mindful of the fact that these jobs, as Petro-Canada has pointed out, are highly seasonal and are of very short duration.

As hinted at in the company's statement, the project will probably contribute few long-term employment benefits. Of the 40-45 permanent positions available, few could be filled by northerners because

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of the highly skilled nature of the work. Of the region's work force surveyed in 1976: "Only 13 percent (34) of the 267 male respondents had completed grade 9, while fewer still had continued beyond that grade." Grade 10 is the minimal educational requirement for a technical course and obviously, many of the training courses because of their nature could not be brought to communities.

In terms of ship-board employment, it is not apparent that plans to send northern residents to nautical training school have realistically taken into account the difficulty of getting people to attend, graduate and then maintain a commitment to ship-board employment. In addition, problems with powerful unions are virtually ignored and might be a major obstacle beyond the company's control.

None of this is meant to downplay the corporate goodwill that Petro-Canada has displayed with respect to employment of northern and particularly native people. However, the fact is that the actual implementation of corporate employment policies in the North is difficult at best. There is nothing in the promises of Petro-Canada that is different from what has been promised (and rarely delivered) by others. For projects like the APP it is worth asking whether short-term, largely unskilled wage employment is actually in the long-term interest of the region. Are there other, more rewarding, longer-lasting opportunities that could or should be made available? Do ventures like the APP foreclose other more desirable options? Will the APP, like other large development projects in the North, actually

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marginalize the native people despite the hopes of the proponent? Perhaps the time has now come to recognize that multi-billion dollar, high technology ventures such as the APP cannot be expected to solve or even significantly alter regional employment problems on their own.

3.2.3 Land claims

Some time during the forecast life of the APP (20.5 years) there will probably be a settlement of native claims in the High Arctic. Certainly government policy would lead one to such a conclusion. Petro-Canada says only that it "is prepared to respond positively to the spirit of any settlement or partial settlement between the Inuit people and the Government of Canada." If the policy statement is intended as a declaration of support (despite curious mention of a "partial" settlement), it represents a commendable position for the company. However, the statement must be clarified because it does little to address problems related to land claims which the APP will cause. Granted, claims negotiations are, strictly speaking, a matter between government and the Inuit. But the APP places Petro-Canada firmly in the middle of a negotiating process that includes everything from political controls and regulatory authority to resource and property rights. The land claims issue is critical to an understanding of the socio-economic aspects and perhaps the environmental aspects of the APP. However, as far as can be determined, the Inuit Tapirisat has not been approached on the main policy issues such as employment, the establishment of a new community, the effects on

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local and regional government, equity participation, royalties, title and compensation. These are all elements affecting a land claims settlement.

Native people have a large stake in the industrial future of the North which includes Petro-Canada's project. It remains unclear, however, how the APP would fulfil the aspirations of Inuit so that it would, as Petro-Canada states, "...demonstrate tangible benefits to northerners..." There are many case studies that Petro-Canada could have developed to pursue this matter as it might affect their project. The Alaska, James Bay and COPE agreements and the Shetland Island experience are examples. Commissioning of such studies and conducting them in light of the development that the Arctic Pilot Project would bring, would go a long way in helping the company, the Inuit and even the government to determine the best way to proceed.

CARC believes that as a prerequisite to the development of any major resource in the North, all claims must be settled. In our view, that will establish a solid foundation for meaningful involvement of the Inuit. That alone will turn the tide and make national northern developments a positive regional force. And that alone will take Inuit involvement beyond the state of advisory committees and a few jobs.

A term and condition on the APP must require a settlement of the relevent Inuit claims. To borrow Petro-Canada's approach, perhaps

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the APP should also be the "pilot" for native claims settlement and concurrent regional development. Perhaps that is what is alluded to when the company's policy statement introduces the concept of a "partial" settlement.

3.3 Industrial, Technical and Sovereignty Factors

Petro-Canada's cost-benefit analysis lists an acceleration in technological development and a strengthening of Canadian sovereignty in the arctic archipelago as "supplementary benefits" that would result from the Arctic Pilot Project. These supplementary benefits take on an added importance in light of the energy analysis given above. Not surprisingly, Petro-Canada has given special emphasis to some of these benefits, particularly the technological spin-offs, in its promotion of the Pilot Project. The potential national signficance of these benefits requires that they be assessed carefully. They may, in themselves, be sufficiently compelling to dominate final decision-making on the APP.

3.3.1 Sovereignty

Petro-Canada argues that the APP would strengthen Canada's claim to sovereignty over the islands of the arctic archipelago and its surrounding waters. Establishing a Canadian presence and having Canada accepted as sovereign, however, are two entirely different matters.

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First of all, it is necessary to point out that Canada's claim to the arctic archipelago is sound.* What is at issue is Canada's assertion that the waters between the islands, and more specifically, the Northwest Passage, are internal and therefore subject to exclusive Canadian jurisdiction. The United States, for one, has never recognized that claim. The APP will not lead the U.S. to abandon its position that the Northwest Passage is an international strait. On the contrary, it is more probable that the APP's demonstration of year-round navigation in the Arctic will encourage the U.S. to take advantage of this new transportation route to deliver Alaskan resources to east coast markets.

Although the APP will literally wave the Canadian flag over arctic waters, it will not increase the country's political sovereignty over them. This conclusion is shared by Transport Canada, which in its 1979 Background Paper on Deep-Sea Shipping, characterizes the role of such commercial ships in asserting arctic sovereignty as "doubtful."

3.3.2 The industrial and technological opportunity

One of the strongest arguments in support of the Arctic Pilot Project concerns the potential it provides for establishing Canadian excellence in arctic science and technology. It could also provide

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* For an outline of the sovereignty issue see CARC's Arctic Seas Bulletin, vol. 2, no. 2 (February 1980).

exceptional benefits to Canadian industry and the growth of the economy in the Atlantic Provinces. In CARC's view, either of these aspects of the APP offers tremendous opportunities for Canada.*

The implications of the Pilot Project or a similar year-round shipping venture for Canadian science, technology and industry have been discussed in a wide variety of fora already. In the opening remarks to the 1977 seminar on the marine transportation of arctic natural gas, the executive director of the Science Council stated:

> The technical options of pipeline and tanker modes of gas transportation [from the Arctic Islands] are being actively debated. The choice we make should be dictated not only by the increasing urgency of energy demands, but by the equally important, long-term need to create a technical, industrial capability that will support our political and economic sovereignty.**

The National Research Council has published "Steering a Course to Excellence", a study by Pallister Resource Management which examines the Canadian offshore oil and gas industries. It recommends that "a strong focus be placed on developing ice technology in Canada

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* In 1978, at CARC's Second National Workshop on People, Resources and the Environment North of 60° , a special working group tackled the arctic seas and marine transport issue. That spawned CARC's ongoing Arctic Seas Study and the 1979 Montebello Symposium on Marine Transportation and High Arctic Development: Policy Framework and Priorities. Proceedings of both workshops that outline in detial many of the issues raised here are available from CARC in Ottawa.

** Science Council of Canada et al., Proceedings, p. 5.

with a priority to exploiting Canadian resources, stressing new concepts..."*

The Department of Industry, Trade and Commerce (IT&C) has established twenty-two industry sector task forces (which reported in 1978) to recommend to government appropriate action to improve the economic performance of Canada's industrial community. The report by the sector task force on the Canadian ocean industry outlined the measures which, if implemented, would create a healthy environment for that "small, fragmented and under-capitalized" industry. It was the opinion of the task force that "a more direct and positive approach is needed to address the development of Canadian technology for Canadian offshore resources."**

The IT&C task force dealing with the Canadian shipbuilding and repair industry dealt specifically with arctic shipping and said:

> ...the potential for business in the Arctic could be enormous... [and] could easily run to many billions of dollars over the next 10 to 20 years.
>
> The Committee considered that an Arctic pilot project with an approximate value for shipbuilding and marine components of (Can) $800 million is indeed far more than a pilot project. Great concern was expressed that if the

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* Pallister Resource Management Ltd., "Steering a Course to Excellence," a study of the Canadian Off-shore Oil and Gas Service Industries, conducted for the National Research Council of Canada (Calgary, 30 June 1977), p. iii.

** T. Nickerson (Chairman), Report on the Ocean Industry by the Consultative Task Force, (Ottawa :Department of Industry, Trade and Commerce), executive summary and p. 12.

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> first of these vessels are procured offshore, all others would follow as the country which builds the first true Arctic class vessels will have a significant lead over all others.
>
> If Canada does not now act to protect its resources and optimize industrial benefits, other nations will take advantage of the resources and the industrial opportunity.

The task force then made the following recommendations with which the government subsequently agreed. It is this recommendation more than any other that holds the key to establishing a Canadian expertise in arctic marine technology:

> Suitable long-term (10 to 15 years) industrial policy should be defined in relation to Arctic development so that all parties involved may be aware of the ultimate policy requirements and are able to take full advantage of long-term future...

Although all these reports emphasize shipping, they should not obscure the fact that the potential technological spin-offs in the development of marine systems in the Arctic go well beyond ships and ship hardware. The boost it will give to the electronics industry in developing arctic navigational aids, and to the engineering of special arctic port facilities, offshore and subsea structures is important as well. The development of the actual arctic class ice-breaker (which has been "endorsed" by the government for some time) is just the tip of the technological and industrial iceberg.

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*A.A. McArthur (Chairman), A Report by the Sector Task Force on the Canadian Shipbuilding and Repair Industry (Ottawa: Department of Industry, Trade and Commerce), pp. 4-5.

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It its discussion of the industrial benefits the APP could bring, Petro-Canada, however, has not gone beyond statements of general intent. It states the hope that the LNG and other construction knowledge gained through the APP will provide new opportunities to expand technical and industrial activities to other areas, some of which amy be outside Canada. It claims that the design and operation of LNG icebreaking carriers will open the way to other arctic resources and will move Canada to the forefront of world icebreaking technology. In all cases, Petro-Canada promises that where "practicable" the project would be "substantially" of Canadian content. These are all laudable ideals, but they fall far short of what is necessary if the Pilot Project is to meet its full potential as a "pilot" venture.

It is essential to place ventures such as the APP in the context of a long-term industrial policy. Canadian content *per se* is not the issue. While beneficial, it will not solve the industrial and economic challenge of developing frontier (arctic and east coast) regions. Content and other regulations will only be effective if there is the development of relevant, indigenous technological expertise. The development of this expertise must start somewhere and it must be nurtured through the early stages of development with firm resolve in both government and industry.

Canada already took a first step with the M.V. Arctic. In the report, Background Paper on Deep-Sea Shipping, published in October

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1979 by the Shipping Policy Branch of Transport Canada, the pilot nature of the 1979 commissioning of the M.V. Arctic is described:

> ...the government entered into a joint industry-government pilot project for construcstion and operation of a medium size Canadian flag icebreaking bulk carrier [M.V. Arctic]. This pilot project was initiated to provide government leadership and financial assistance to the shipping industry to develop and prove Arctic class ship technology and to head off further initiatives in this direction by foreign nations.*

Since then Dome Petroleum has taken another step. The 1979 commissioning of their Canadian designed and built icebreaker Kigoriak has moved that company forward so that it is now obtaining direct information against which it can test the feasibility of moving hydrocarbons through the Northwest Passage in ships.** In addition, the Canadian Coast Guard is continuing planning for a Class 7 or 10 icebreaker.

While all these developments hold great promise and opportunity for developing a solid Canadian capability in arctic marine technology,

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* Transport Canada, Shipping Policy Branch, Background Paper on Deep-Sea Shipping (October 1979), p. 33.

** Interestingly enough, Dome's current planning envisions oil tankers moving through the Northwest Passage by 1985 - a year before the start up of Petro-Canada's "pilot" project.

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there is little indication that government or industry commitment has been made to achieve that goal. Without a solid commitment and a long-range plan, opportunities will be lost until there is little hope for developing a strong industrial and technological presence. Already, in a 1979 decision related to the Arvik mine, a policy to require all arctic shipping to be designed, built and crewed by Canadians has been compromised and an opportunity has been lost. Now, Petro-Canada says that despite a 20 per cent federal shipbuilding subsidy and a 25 per cent duty on foreign-built ships used in Canadian internal trade, it will not be building the two LNG carriers in Canada because the infrastructure does not exist in Canadian shipyards.

The Pallister report, "Steering a Course to Excellence", stresses the lack of a comprehensive approach by either industry or government to issues such as those faced in the APP. Recognizing that there are serious market problems that are impeding growth prospects, the report points to the hesitancy of the ocean services industry to make the investments that will be necessary to move them into an internationally competitive position. This hesitancy is due in part to an absence of clarity in the government's commitments. Pallister points out that all nations which have achieved a strong presence in ocean technology have relied on government leadership to assist local service companies to develop chosen technologies through direct and indirect research and development support.

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In the internationally-respected Norwegian Shipping News (25 January 1980), the situation was put rather bluntly:

> ... [A] very important factor spurring development [of Canadian deep-sea capability] is the priming of Canada's arctic frontier, the nation's repository of mineral wealth and the country's key to energy self-sufficiency...If Canada does not place an emphasis on developing an ice class fleet, Northern shipping would be left to Northern European and Russian fleets. The limited number of carriers with experience in arctic type shipping could lead to cartilisation and high shipment costs. A high Canadian activity in the early phases would give the Canadians a foothold. *

Clearly the APP could, if certain conditions were met, have great merit in establishing such a foothold. Whether the project is the optimal way to begin or whether other alternatives such as the construction of a Coast Guard Class 7 or 10 vessel are better, remains to be evaluated. However, the Pilot Project is well-advanced and does have a commercial base (though still unproven) and for that reason alone it may be the opportunity not to be missed. Unfortunately, without more specific information, it is impossible to weigh these potentially positive national industrial and technological opportunities against the risks and costs inherent in the Petro-Canada proposal. Without that information, it is very difficult to support anything but the concept of year-round arctic navigation. The concept is worth pursuing, but not at *any* cost.

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* "Deep-sea Capacity for Canada," Norwegian Shipping News, no. 1 (1980): pp. 64,67.

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4. SUMMARY AND RECOMMENDATIONS

In this submission CARC has concentrated on those aspects of the project that seem most critical in arriving at a firm understanding of the Arctic Pilot Project. In so doing, we recognize that there are a great many other issues that have to be addressed. Nowhere have we dealt with specific aspects of gas production facilities, the Melville Island pipeline, the Bridport Inlet infrastructure, or the specific environmental risks that might be engendered along the proposed route. That is not to say that these considerations are not essential to a review of the project. They are. For example, it is vitally important to examine the implications for threatened or endangered species such as the Peary caribou (Melville Island) and the bowhead whale (Baffin Bay) in careful detail. The implications for IBP sites, parks and the Green Paper being prepared for Lancaster Sound are also important. The regional significance of developments such as the Arvik mine and Dome's leases in Viscount Melville Sound must also be borne in mind. These and many other issues will be raised during the public hearings.

However, in reviewing the Arctic Pilot Project it became apparent that any assessment would have to proceed on certain assumptions. Without carefully examining these assumptions, testing their strengths, probing their weaknesses and evaluating the scope of their implications, CARC felt that the assessment itself and the recommendations it might develop would be in serious jeopardy. There is great danger in succumbing to the argument that certain aspects and not others belong to only one forum for review purposes. But looking at a project one piece at a time and

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ignoring the whole gives rise to incidental and incremental pickings, not assessment. A project, like the environment, must be understood and viewed in its totality if sound decisions are to be made.

Our assessment shows that the Arctic Pilot Project should not proceed unless it is substantially modified. Although CARC has argued that Canada must develop year-round capability in arctic seas, the project *as presently envisaged by Petro-Canada* offers too many risks and fails to demonstrate sufficient advantage to be acceptable. The venture does not even live up to the benefits claimed by the proponents.

First and most fundamentally, we must appreciate the fact that the APP is an energy proposal to move Melville Island gas to markets in eastern Canada, and by displacement, twice as much Alberta gas to U.S. markets. It is an energy export scheme, and as such, it does not measure up against Canada's energy needs and priorities. At the same time, it exposes Canada to significant risks. It may lead to excessive gas exports. It will create a dependency for east coast consumers on a more expensive and less-secure natural gas supply than is available from other sources. At the same time, by high-grading frontier reserves, the Pilot Project may foreclose other more viable options for moving High Arctic gas to markets in the South.

Second, the APP is not a "pilot" in the normal sense of that word. It is a permanent large-scale venture in its own right, and must be treated as such. The project will bring with it major concerns about

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increased marine traffic, regional growth, and industrial and technological opportunity.

As the first year-round venture to move arctic resources – particularly hydrocarbon resources – by the marine mode, the APP will establish arctic shipping corridors that could, within this century, be subject to about 1000 transits per year. While a commendable pioneering venture, this project therefore raises concern because of its paucity of data on the physical environment, and because it fails to take into full account alternate routings which avoid areas of environmental, socio-economic and political sensitivity. In fact, the proposed routing will establish a corridor through those areas that are of greatest sensitivity. In so doing, Petro-Canada fails to recognize that the first mitigative measure is not compensation (which it inadequately deals with) but rather re-routing.

The APP will also act as a catalyst for regional growth by establishing a second marine and air base in the High Arctic. This will have long-term effects that Petro-Canada has not accepted – effects on the environment, employment, population redistribution and native land claims.

At the same time the APP brings with it the possibility for a substantial contribution to Canadian science, technology and industry. Recognizing that there are many obstacles and risks inherent in the development of the APP, it may be that the venture is worth pursuing even if the economic outlay and resource commitment is rather high. Unfortunately, on the basis of the information now available, a determination cannot be made about how the APP or any similar venture

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could act as a catalyst within a national or northern development strategy. In fact, without much more affirmative action by Petro-Canada and by the government, the APP may leave Canada at a permanent competitive disadvantage in the field of arctic shipping and technology.

Although the Pilot Project as presently constituted should be rejected, the concept behind it does not suffer from any necessary or permanent conflict with the public interest. CARC believes that the concept behind the APP is sound and that the project itself can be improved substantially through a combination of the following measures:

- The APP should tap a different, more remote source of gas - probably King Christian Island.
- The APP should export directly (through a LNG terminal in Canada) rather than through displacement.
- As a demonstration project, the access that the APP provides to frontier reserves must not be considered to increase Canada's exportable surplus from conventional reserves.
- The APP must establish its shipping routes away from environmentally important areas in the first instance, and demonstrate the viability of a number of routes other than the presently proposed route. This should be done assuming the establishment of a shipping corridor that would involve 1000 transits by the year 2000 of vessels carrying a variety of hydrocarbons and other minerals.
- Petro-Canada must establish the exact context within which all parts of the APP — including its ships — will foster the development of Canadian technological excellence.

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- Petro-Canada must address the regional implications of establishing a permanent base in the western High Arctic.

On the government side, at least four fundamental steps should be taken to facilitate the kind of venture envisaged in the APP.

- The Department of Industry, Trade and Commerce must lead in the establishment of a long-term industrial plan to maximize the opportunities offered by development of an arctic marine technology. Such social — as distinct from purely commercial — analysis should attempt to address the total national benefits of a venture such as the APP for Canadian industry, science and technology. The study must consider the opportunity not only of an arctic pilot-type project but the total package of marine developments pending in Canada's arctic and east coast frontier areas.

- The Department of Indian Affairs and Northern Development must take the lead, along with Inuit Tapirisat, Environment Canada and the territorial government, in developing a master plan framework for the western High Arctic.

- The government should review the adequacy of all laws and regulations pertaining to shipping in the Arctic and implement those changes — particularly in the area of compensation — necessary to provide adequate protection of the northern environment and of people faced with a high volume of year-round shipping.

- Land claims negotiations at the Cabinet level should begin to explore the possibility of interim Inuit involvement and control over decisions related to the APP.

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APPENDIX

Marine Traffic Forecast: Northwest Passage

APPENDIX

Marine Traffic Forecast: Northwest Passage

In the last decade the marine mode of moving arctic resources to market on a year-round basis has become more attractive. The forecasting of the future use of this mode is difficult as market situations, commodities and national priorities will continue to shift. This will cause shifts in the annual and seasonal demands for transport facilities with concomitant change in economic and environmental effects.

Although there are a variety of summer resupply operations, there is at present only one commercial shipment (concentrate from the Nanisivik mine). Future year-round proposals include the shipment of hydrocarbons from the Alaskan North Slope, the Beaufort Sea and the Arctic Islands, and minerals from Bathurst Inlet and Little Cornwallis Island. Other potential mineral developments that will affect the region, though probably not requiring routing through the Northwest Passage, involve huge iron ore deposits on northern Baffin Island and on the Melville Peninsula. Exploratory drilling in Baffin Bay and Lancaster Sound will also involve shipping in the area, and if commercial discoveries of hydrocarbons are made, their transportation to southern markets will ultimately involve the marine environment.

Projects requiring west to east transit of the Northwest Passage will ultimately pass through Lancaster Sound, the eastern entrance and undoubtedly one of the most environmentally significant parts of the passage. We will therefore calculate the total number of ship transits that could be expected through Lancaster Sound and break down the assessment according to commodity and region of origin.

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A.1 Oil and gas*

Oil and gas shipments could originate in three areas: the Alaskan North Slope, the Beaufort Sea and the Arctic Islands.

Alaskan North Slope: Four proposals for the marine transportation of North Slope oil have been made to date. First, Seatrain has proposed the shipment of 164,000 barrels of oil a day by a fleet of three Class 8 tankers (225,000 dwt) making 13 round trips annually. This proposal would result in 78 transits through the Northwest Passage a year.

Second, Globtik has proposed the shipment of 2 million barrels of oil a day by a fleet of 24 tankers (350,000 dwt) making 12 round trips annually. This would result in 576 transits of the Northwest Passage a year.

Third, Dome Petroleum has proposed the shipment of 100,000 barrels of Alaskan oil a day by two Class 7 tankers (200,000 dwt) travelling in tandem with larger Class 10 icebreaking vessels. These four vessels would make 12 to 13 trips a year, resulting in 96 to 104 transits annually.

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* For a background on shipping forecasts, three Transport Canada reports are of interest: "Forecasts of Marine Shipments of Arctic Oil and Gas," prepared by the Strategic Planning Branch, Strategic Planning Group in Montreal on 7 September 1979; a paper entitled "Arctic Marine Vessel Traffic Density Estimate" (no date); Arctic Marine Transportation Forecast of Ship Movements:1985,1990,1995 (Draft), prepared by Forecasting and Information, Marine Planning Division, Marine Policy and Planning Branch, Canadian Marine Transportation Administration in October 1979.

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Finally, the U.S. Maritime Administration has considered the use of nuclear-powered tankers (250,000 dwt) to carry 2 million barrels of oil a day. Twenty-six vessels making 19 round trips a year would be required to maintain this throughput, resulting in 998 transits a year.

Commercial thresholds necessary to support any of the above projects do not yet exist. The current reserves are estimated at 9.4 billion barrels. The movement of this oil by the existing Trans-Alaska Pipeline will exhaust the reservoirs within the next 20 years. As present production declines, new discoveries would be incorporated into the pipeline (with a capacity of 2 million barrels a day). Oil for marine shipment must therefore come from as yet undiscovered reserves in areas distant from the existing pipeline. Such discoveries are considered probable and, if only 730 million barrels were found, it would be sufficient to support the comparatively modest Dome proposal (up to 104 transits per year) over 20 years. Since this is the least number of transits anticipated in proposals to date, it will be used in the forecast of possible shipping below.

Beaufort Sea: For the shipment of Beaufort Sea oil, Dome Petroleum, in a December 1978 report entitled Evolution of Marine Support and Transportation Systems to develop Beaufort Sea Hydrocarbons, envisages a fleet of about 24 Class 10 supertankers each making 12 round trips annually, resulting in a total of 576 transits a year.*

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* It is interesting to note that Dome's proposal for Alaskan North Slope oil involves Class 7 tankers travelling with Class 10 icebreaker support while Beaufort Sea proposals involve only the use of Class 10 carriers.

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Arctic Islands: Three proposals have been developed for the tapping of Arctic Islands hydrocarbons using the marine mode. First, of course, the Arctic Pilot Project has proposed the shipment of LNG in two Class 7 icebreaker carriers, each making 14 to 15 round trips annually. Ignoring the possibility that additional ships would be added, this would result in about 60 transits a year.

Second, TransCanada PipeLines has considered the shipment of LNG from King Christian Island through Wellington Channel and Lancaster Sound (or possibly through Jones Sound) by three Class 10 icebreaking carriers. They would make approximately 10 trips each, resulting in 60 transits annually. The Arctic Pilot Project, if successful, would certainly accelerate interest in such a scheme.

Third, Panarctic Oils has considered the shipment of Bent Horn oil (on Cameron Island) from a terminal on southeast Bathurst Island. Assuming the production of 50,000 barrels per day envisaged by Panarctic, one Class 7 tanker (200,000 dwt) making 15 trips and hence 30 transits a year would be probable. This project, however, is dependent upon future discoveries of commercial quantities of oil in the region.

If we accept that these three Arctic Islands projects may come on stream and will be developed to their presently conceived full potential (it could be greater since any single development will accelerate exploration) a possible 150 transits a year could result.

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A.2 Minerals

Forecasting the marine transportation requirements for hard rock minerals is more speculative than for hydrocarbons since market forces fluctuate and the strategic value of the commodities is less. The 1979 draft study prepared by Transport Canada (Arctic Marine Transportation Forecast of Ship Movements 1985, 1990, and 1995) developed a number of scenarios for such mineral shipments. Tailoring that study's findings to the probable developments that would involve Northwest Passage shipping, it is apparent that there are three main origins for vessel traffic.

First, there is the existing Nanisivik mine on northern Baffin Island. It is expected to continue to give rise to about 12 transits a year (summer only) in Class 2 ships (28,000 dwt).

Second, Cominco's Polaris mine on Little Cornwallis Island, recently given the go ahead, will be brought into production in 1982. It will probably require 8 shiploads of concentrates a season (in 28,000 dwt, Class 2 carriers) resulting in 16 transits annually.

Finally, there are four bodies in the Bathurst Inlet area. Two of these deposits — Hacklett River and Izok Lake — are very large lead-zinc, copper and silver bodies.* The price of base metals is expected to climb and it is considered probable that these bodies would be brought into production in the 1990s. Based on a forecast of a combined annual

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* The other two deposits are considerably smaller and are not considered in this calculation.

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concentrate production r te of 329,000 metric tonnes, 32 transits (16 shiploads) in Class 6 vessels would be required annually. (Of course, the use of larger vessels would reduce the number of vessels required and therefore the frequency of transits).

The combined number of vessel transits involved in the above transportation of minerals would therefore be about 60 annually.

A.3 Combined shipping frequency estimate

Employing the above calculations, the total number of transits for all hydrocarbon and mineral vessels would be about 890 a year. If we include community resupply (generally involving two to three ships a year for each community), industrial development, industrial resupply, the potential construction of the Polar Gas pipeline, scientific research vessels, Canadian Coast Guard icebreaker support, the Department of National Defence operations and offshore oil and gas exploration in Baffin Bay/Lancaster Sound, the Beaufort Sea and perhaps in Viscount Melville Sound, about 70 or so more transits should be added.

It would not be unreasonable, therefore, to anticipate about 1000 transits a year through the Northwest Passage by the year 2000, although actual origins and seasonal preferences may change this order of magnitude. This is what Petro-Canada's "pilot" project, if successful, will bring in its wake.